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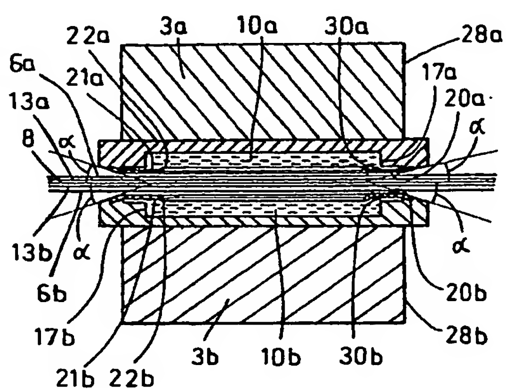
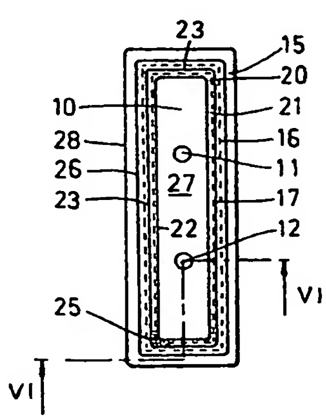
(54) Title: LONG NIP PRESS FOR MACHINES TRANSPORTING FIBRE WEBS



(57) Abstract: A long nip press for machines transporting fibre webs, which press drains water from the fibre web (8) and comprises two hydrostatic bearings opposite each other, both comprising a pressure shoe (3a and 3b) comprising a pressure chamber (10a, 10b), the pressure shoe having a sealing element in the form of a flexible pressure-balancing diaphragm (20a, 20b), and a press belt (6a and 6b) to press the fibre web (8) against a fabric (13a, 13b), the pressure-balancing diaphragm (20a, 20b) protruding on its edge-zone (21a, 21b) without support from the inner rim of the pressure shoe towards the pressure chamber (10a, 10b). So as to make the long nip press very simple in structure and to enable self-adjusting, even and efficient lubrication in the nip, the protruding edge-zones (21a, 21b) comprise pinholes (25) for transporting hydraulic fluid. The invention also relates to a pressure-balancing diaphragm.



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LONG NIP PRESS FOR MACHINES TRANSPORTING FIBRE WEBS

[0001] The invention relates to a long nip press for machines transporting fibre webs, such as paper and board machines, which press drains water from the fibre web and comprises a hydrostatic bearing and a press belt sliding on the bearing to press the fibre web against a press roll in such a manner that the fibre web when moving presses against at least one fabric, the bearing comprising a pressure shoe comprising at least one pressure chamber, and on the surface of the pressure shoe that is towards the press belt, there is a sealing element in the form of a flexible pressure balancing diaphragm and comprising an outer rim, an inner rim and an opening defined by the inner rim, the pressure balancing diaphragm being supported by the pressure shoe, but protruding from the inner rim of the pressure shoe towards the pressure chamber in such a manner that on its protruding edge-zone, it is at least mainly unsupported, whereby its inner edge is free, and the pressure balancing diaphragm being made of a material, the rigidity of which enables it to bend during use according to hydraulic pressure changes occurring in the area of the pressure shoe away from the press roll and correspondingly towards the press roll in such a manner that hydraulic fluid can flow away from the nip from the area between the press roll and the pressure shoe, and when the hydraulic fluid flow exceeds a certain value, the pressure balancing diaphragm is adapted to bend towards the press roll to reduce the hydraulic fluid flow.

[0002] The invention also relates to a long nip press according to the preamble of the attached claim 2.

[0003] A long nip press of the kind described above is known from Finnish patent publication 94368. An advantage of the press is that it provides a good and even drying result in a web being dried, and it endures long-time use, thus eliminating the very expensive shutdowns caused by the production breaks of a paper machine. Due to its free and flexible edge-zone, the pressure balancing diaphragm of the pressure shoe is self-adjusting in such a manner that if there is leakage causing locally, close to the upper part of the pressure shoe, a decrease in hydraulic pressure, the free edge of the diaphragm bends towards the press roll (or an opposing pressure shoe) until the same pressure prevails on both sides of the diaphragm edge. This way, the fibre web is pressed in the nip at an even pressure and the drying result is even. In addition, this known press is relatively simple in structure and when necessary can easily be installed afterwards in paper and board machines

without requiring any major modification work. The lubrication of the press is implemented by lubricating ducts on the outer rim of the pressure shoe, from which the lubricant flows towards the press belt through ducts built on the outer rim of the sealing list covering the pressure shoe.

[0004] Even though the above long nip press functions well, the present invention discloses improvements to the known long nip press that aim to further simplify the structure of the press and to provide an efficient, self-adjusting lubrication in the area of the pressure shoe.

[0005] To achieve said aim, the long nip press of the invention is characterized in that the protruding edge-zone of the pressure balancing diaphragm comprises pinholes for transporting hydraulic fluid in the pressure chamber from the pressure chamber to the press belt to lubricate the press belt.

[0006] In this context, the term 'pinhole' refers to a hole having a very small diameter. Alternatively, said pinholes can be called microholes. The diameter of the hole is in the range of 0.01 to 50 micrometers.

[0007] An alternative implementation of the invention is characterized by what is stated in the characterizing part of the attached claim 2.

[0008] The invention is based on the idea of implementing lubrication through the free edge-zone of the pressure-balancing diaphragm, which means that the structure of the pressure shoe can be considerably simplified and the sealing list left out. By moving the lubrication away from the outer rim of the pressure shoe, the size of the pressure shoe can be reduced, in which case upper surface of the pressure shoe is preferably bevelled towards the outer rim of the pressure shoe in such a manner that the bevelled section forms an angle of 5 to 10 degrees with respect to the top level of the pressure shoe. This provides a better drying process, because the web being dried detaches faster from the fabric and there can be no significant rewetting from the fabric towards the web when the web moves on from the pressure shoe.

[0009] Preferred embodiments of a long nip press of the invention are disclosed in the attached claims 3 to 10.

[0010] The greatest advantages of the long nip press of the invention are that it is very simple in structure and it enables a self-adjusting, even and efficient lubrication in the nip. No lubrication channels are needed inside the body of the pressure shoe. When pressure increases in the nip, the seeping of the lubricant through the pinholes in the pressure-balancing diaphragm

also increases, because the lubricant then passes through the pinholes at a higher pressure. In addition, the invention makes it possible to use a small pressure shoe, in which rewetting seldom occurs. Further, the invention is easy to install in paper and board machines (or other machines transporting webs) even afterwards without requiring any major modification work.

[0011] The present invention also relates to a pressure-balancing diaphragm comprising an outer rim, an inner rim and an opening defined by the inner rim. The pressure-balancing diaphragm of the invention is characterized in that it comprises pinholes in an edge-zone close to the inner rim.

[0012] The main advantages of the pressure-balancing diaphragm of the invention are that it enables the advantages mentioned above.

[0013] In the following, the press of the invention will be described in more detail by means of two preferred embodiments and with reference to the attached drawing, in which

Figure 1 is a schematic side view of the press,

Figure 2 is an end view of the press of Figure 1,

Figure 3 is a cutaway view along the line III - III of Figure 1,

Figure 4 is a schematic representation illustrating a cross-profile at the long nip,

Figure 5 is a top view of the pressure shoe of Figure 4,

Figure 6 is a more detailed end view of the structure of the pressure shoe, and

Figure 7 shows an alternative embodiment at the long nip.

[0014] The long nip press of Figure 1 for drying a fibre web comprises a body and on it, a press roll 1, long nip 2 and a hydrostatic bearing in association thereto and comprising a pressure shoe 3, and guide rolls 4, 5 for supporting and rotating a belt 6, i.e. a fabric-reinforced press belt. In addition, the press comprises guide rolls 7, 9 for guiding press fabrics 13, 14 and the fibre web 8 being dried to the nip 2, in which water drains from the web 8. The reference number 9 indicates a guide roll of the fibre web 8.

[0015] In Figure 2, the press of Figure 1 is shown as seen from the right end, and for the sake of simplicity, the guide roll 9 and structures closely connected to it are left out. The figure shows that the width of the nip 2 corresponds substantially to the length of the press roll 1.

[0016] Figure 3 is a cutaway view along the line III - III of Figure 1. The figure shows that the pressure shoe 3 comprises only one pressure

chamber 10 that is defined by the inner rim of the pressure shoe (cf. reference number 17 in Figure 6). Because there is only one pressure chamber, the web 8 remains unmarked, i.e. without unwanted tracks, by any unevenly affecting hydraulic pressures in the pressure shoe 3. The hydraulic fluid enters the chamber 10 though openings 11, 12. The hydraulic fluid is preferably water preferably with additives improving lubricating properties and reducing surface tension.

[0017] Figure 4 illustrates how the fibre web 8 goes into the long nip 2. The press belt 6 rotates (moves) on top of a fluid bed of the pressure shoe 3 with a very small friction, and the fibre web 8 goes into the long nip in such a manner that it is between the press fabrics 13 and 14. When the web 8 is pressed between the press fabrics 13, 14 at the long nip 2, the fabrics suck water from it. Two fabrics 13, 14 are not necessarily needed; it is possible that there is a fabric on only one side of the web 8. Using two fabrics 13, 14 is, however, recommended, because this way the drying is more efficient.

[0018] Figures 4 and 6 show that there are bevels 15 on the edges of the top surface 19 of the pressure shoe 3 towards the outer rim 28 that forms an angle α with respect to the top level of the pressure shoe. Figures 5 and 6 show that the pressure-balancing diaphragm 20 is a rectangular structure comprising an outer rim 26, inner rim 22 and an opening 27 defined by the inner rim. Recesses 29 are made in the bevels 15 for receiving the outer rim 26 of the pressure balancing diaphragm 20 in such a manner that the outer rim of the diaphragm 20 supports itself against the shoulder or notch 19a of the recess and the top surface of the diaphragm 20 is level with the top levels of the bevels in the edge-most zones of the pressure shoe. The angle α is 5 to 10°. Figure 4 shows that the press belt 6 is not transported in such a manner that it rests against said bevels 15, but the press belt forms an angle β with respect to the top level of the bevel 15 with the angle β being smaller than the angle α. The angle β is 2 to 5 degrees smaller than the angle α, and its absolute value is preferably in the range of 3 to 7 degrees. The reference number 23 marks the top point defined by the bevel on the top surface of the pressure shoe.

[0019] Figure 5 shows the pressure shoe 3 from the top, thus showing its rectangular shape, and Figure 6 is an enlarged and more detailed cutaway view of the pressure shoe along the line VI - VI of Figure 5. For the sake of simplicity, Figure 6 does not show the fibre web 8, press fabrics 14, 13 or

press belt 6 that are shown in Figure 4.

[0020] The pressure-balancing diaphragm 20 is a plate-like diaphragm made of stainless steel and welded to the bevelled area 15 of the pressure shoe 3 with a weld joint forming a rim, shown by a dashed line 16. There may be several weld joints 16. The pressure-balancing diaphragm 20 covers the pressure shoe 3 in such a manner that it can be supported by the top surface of the recess 29. The notch 19a is next to the weld joint 16 and closer to the outer rim 28 of the shoe 3 than the weld joint. Instead of a weld joint, the pressure-balancing diaphragm 20 can preferably be fastened to the top surface of the recess 29 by a glue joint. An advantage of the glue joint is that it does not cause a point of discontinuity in the material of the pressure-balancing diaphragm 20. Below the edge-zone 21, there is a slot 30 that makes the pressure balancing diaphragm 20 protrude in its edge-zone 21 towards the pressure chamber 10 without or at least mainly without support for a length, i.e. distance, of S = 20 - 40 mm. The slot 30 allows hydraulic fluid to enter below the edge-zone 21. The length L of the slot 30, i.e. its distance from the inner rim 17 of the pressure shoe to the point where the diaphragm 20 is supported, is for instance 10 to 40 mm and its thickness is for instance 1 mm. The inner edge 22 of the edge-zone 21 of the pressure-balancing diaphragm 20 is free. The purpose is that the pressure balancing diaphragm 20 is flexible in such a manner that its edge-zone 21 bends at the top part of the pressure shoe 3 according to the prevailing pressure changes towards the roll 1 and correspondingly away from it.

[0021] The top surface of the pressure-balancing diaphragm 20 comprises numerous very small holes 25, so-called pinholes, having a diameter of 1 to 10 micrometers for lubricating the press belt 6. The lubrication keeps the friction of the pressure shoe against the press belt 6 very small and due to good lubrication, the pressure-balancing diaphragm 20 endures long-time use. It is difficult to achieve good lubrication in known pressure shoes, especially in the section of the pressure shoe that is on the side of the inlet nip. This is the case despite the provision of the lubrication channels in the body of the pressure shoe. The pinholes 25 are illustrated by small dots in Figure 5. For the sake of simplicity, Figure 5 only shows a few dots on the left at the bottom, but the pressure-balancing diaphragm 20 comprises pinholes 25 on the entire edge-zone 21, i.e. on the entire inner rim of the diaphragm. It can be expected that the diameter of the pinholes 25 is outside said range, being for instance in

the range of 0.01 to 10 micrometers. Even the range of 10 to 20 micrometers may be possible in some applications. It is difficult to produce very small pinholes. If the diameter of the pinholes 25 is too small, the lubricant, preferably an aqueous fluid in the pressure chamber 10, cannot even at a high pressure of 20 to 50 bar flow through them or the flow is too slow for good lubrication. Field tests determine a suitable size for the pinholes of the pressure balancing diaphragm 20 and the rigidity (thickness) of the diaphragm 20 so that water can filter through the diaphragm in such a manner that the diaphragm still serves as a sealing. The pressure of the fluid in the pressure chamber 10 is generally in the range of 20 to 100 bar when the web 8 is transported. If the diameter of the pinholes 25 is too big, the lubricant exits the pressure chamber and the necessary pressure is not maintained in the pressure shoe 3. To prevent the pinholes 25 from being blocked, a filter (not shown) can be used to prevent small particles from entering the pinholes. The shape of the pinholes 25 can vary: they may be round, oblong, elongated, rectangular, etc. Their number and arrangement, for instance into different patterns, can also vary. The pinholes 25 are made using electron beam cutting or laser cutting. The pinholes 25 can be made using for instance the Micro-EDM (Micro Electro-Discharge Machining) system, Model 82, of Panasonic, with which it is possible to make pinholes of different shapes.

[0022] A pressure p caused by the hydraulic fluid prevails in the edge-zone 21 of the pressure-balancing diaphragm 20, the pressure "normally" corresponding to a pressure p1 in the pressure chamber 10. Because the geometry of the nip 2 is not completely constant all the time and because the thickness of the web 8 is not always exactly the same, moments occur when the hydraulic fluid tries to escape from the nip 2 from the area between the roll 1 and the pressure-balancing diaphragm 20. When the fluid escapes and exits the pressure chamber 10, the hydraulic pressure p above the edge-zone 21 of the diaphragm 20 decreases rapidly. As a result of the pressure decrease, an unbalance occurs, with a smaller pressure prevailing above the edge-zone 21 of the diaphragm than below the edge-zone 21. A standard pressure p1 prevails in the pressure chamber maintained by pressure supply means (not shown in the figures with the exception of pressure supply openings 11 and 12) that continuously supply hydraulic fluid into the pressure chamber 10. Because the pressure balancing diaphragm 20 is flexible, its edge-zone 21 protruding from the sealing list bends due to the unbalance in such a manner that

the edge-zone and the free edge 22 of the diaphragm move towards the roll 1. Due to the bending, the pressure p increases in the edge-zone back to the value p1 and the nip geometry returns to normal. Fluid leakage lessens and stops quickly. The pressure-balancing diaphragm 20 adjusts in the manner presented above to the prevailing pressures and provides a self-adjusting nip 2 with no or minimum fluid leakage and an even drying of the web.

[0023] Said flexibility of the pressure-balancing diaphragm 20 is in practice achieved by manufacturing the diaphragm 10 of a suitably rigid material. The material and its thickness determine the rigidity of the diaphragm 20. In this context, the length S of the edge-zone 21 of the diaphragm 20 should also be taken into consideration. The greater the length is, the smaller a force is needed to bend the edge-zone 21. The diaphragm 20 is preferably made of stainless steel, in which case the thickness of the diaphragm is preferably approximately 0.5 to 1 mm. The thickness range of the diaphragm 20 can presumably be approximately 0.2 to 3 mm. If the diaphragm is too thick, it does not bend. The diaphragm could alternatively be made of titanium or a titanium alloy or a composite, in which case it can be made of a carbon fibre-reinforced plastic, for instance PTFE (polytetrafluoroethylene or Teflon). If the diaphragm 20 is made of a material having a lower elastic modulus than steel, for instance a titanium alloy or a composite, its thickness is greater than that of a steel diaphragm, for instance 1 to 5 mm.

[0024] The length S of the free edge-zone 21 of the diaphragm 20 is preferably 10 to 40 mm. The diaphragm 20 is preferably made of a uniform rectangular steel plate that covers the pressure shoe 3 in such a manner that the front, back and side edges of the pressure shoe are covered. This way, the manufacturing of the diaphragm 20 is inexpensive.

[0025] Figure 6 shows further that the inner edge 22 of the edge-zone 21 of the pressure-balancing diaphragm 20 is bent away from the press roll 1, thus preventing the edge 22 of the pressure-balancing diaphragm from damaging the press belt 6.

[0026] Figure 7 shows a most preferable alternative manner of implementing the pressing of the web 8 in a long nip. In the embodiment of the figure, the press roll 1 of Figure 1 is replaced by a pressure shoe 3a. The structure of the pressure shoes 3a, 3b corresponds to the structure of the pressure shoe 3 with the sole exception that in the solution of Figure 7, the pressure shoes 3a, 3b are planar and not curved as clearly shown in Figure 6.

The reference numbers of Figures 1 to 6 are used in Figure 7 for the corresponding components and an 'a' or 'b' is added to the number indicating whether it is a top or a bottom shoe. The pressure balancing diaphragms 20a, 20b of the pressure shoes are planar and self-adjusting using the same principle as the diaphragm 20 in Figure 6. In principle, it is possible to leave out either of the press fabrics 13a or 13b.

[0027] The solution of Figure 7 is cheaper than the solution of Figure 4 to implement, because the large press rolls 1 are not needed. It is also very easy and inexpensive to modernize an old machine using the solution of Figure 7.

[0028] In the above, the invention has been described using only two preferred embodiments, and therefore, it should be noted that the invention can in detail be implemented in many ways within the scope of the attached claims. Thus, it is also possible to have several pressure chambers in the pressure shoe. Because of the pressure balancing diaphragm, several pressure chamber are, however, not necessary. This is an advantage, since several pressure chambers make the structure of the pressure shoe more complex and expensive; in addition, marking often occurs in the web when using several chambers. Differing from what is shown in the figures, the pressure balancing diaphragm can cover the entire top surface of the pressure shoe and extend until the outer rim 28, 28a, 28b of the pressure shoe. It is also possible to fasten the pressure-balancing diaphragm to the pressure shoe in some other manner than welding and glueing. The manufacturing material of the pressure shoe can be other than stainless steel; for instance a water-permeable reinforced pressure-proof plastic or a water-permeable composite film are possible. The press belt can be a round roll. In the example of Figure 1, the pressure shoe is located below the press roll, but it can also be above the press roll.

CLAIMS

1. A long nip press for machines transporting fibre webs, such as paper and board machines, which press drains water from the fibre web (8) and comprises a hydrostatic bearing and a press belt (6) sliding on the bearing to press the fibre web (8) against a press roll (1) in such a manner that the fibre web (8) when moving presses against at least one fabric (13, 14), the bearing comprising a pressure shoe (3) comprising at least one pressure chamber (10), and on the surface of the pressure shoe that is towards the press belt (6), there is a sealing element in the form of a flexible pressure balancing diaphragm (20) and comprising an outer rim (26), an inner rim (22) and an opening (27) defined by the inner rim, the pressure balancing diaphragm (20) being supported by the pressure shoe, but protruding from the inner rim (17) of the pressure shoe towards the pressure chamber (10) in such a manner that on its protruding edge-zone (21), it is at least mainly unsupported, whereby its inner edge (22) is free, and the pressure balancing diaphragm (20) being made of a material, the rigidity of which enables it to bend during use according to hydraulic pressure changes occurring in the area of the pressure shoe (3) away from the press roll (1) and correspondingly towards the press roll in such a manner that hydraulic fluid can flow away from the nip (2) from the area between the press roll (1) and the pressure shoe, and when the hydraulic fluid flow exceeds a certain value, the pressure balancing diaphragm (20) is adapted to bend towards the press roll (1) to reduce the hydraulic fluid flow, **characterized** in that the protruding edge-zone (21) of the pressure balancing diaphragm (20) comprises pinholes (25) for transporting hydraulic fluid in the pressure chamber (10) from the pressure chamber to the press belt (6) to lubricate the press belt.

2. A long nip press for machines transporting fibre webs, such as paper and board machines, which press drains water from the fibre web (8) and comprises two hydrostatic bearings located opposite each other, both comprising a pressure shoe (3a and 3b) comprising at least one pressure chamber (10a, 10b), the pressure shoe having on its surface a sealing element in the form of a flexible pressure balancing diaphragm (20a, 20b) and comprising an outer rim, an inner rim (22a, 22b) and an opening defined by the inner rim, and a press belt (6a and 6b) sliding on a bearing to press the fibre web (8), when it moves, against at least one fabric (13a, 13b), the pressure balanc-

ing diaphragm (20a, 20b) being supported by the pressure shoe, but protruding from the inner rim (17a, 17b) of the pressure shoe towards the pressure chamber (10a and 10b) in such a manner that on its protruding edge-zone (21a, 21b), it is at least mainly unsupported, whereby its inner edge (22a, 22b) is free, and the pressure balancing diaphragm (20a and 20b) being made of a material, the rigidity of which enables it to bend during use according to hydraulic pressure changes occurring in the area of the pressure shoe (3a, 3b) towards the opposing pressure shoe (3b, 3a) and correspondingly away from it so that hydraulic fluid can flow away from the nip from the area between the pressure shoe (3a, 3b) and the surface of the pressure shoe, and when hydraulic fluid flow exceeds a certain value, the pressure balancing diaphragm (20a, 20b) is adapted to bend towards the pressure shoe (3a, 3b) to reduce the hydraulic fluid flow, **c h a r a c t e r i z e d** in that the protruding edge-zone (21a, 21b) of the pressure balancing diaphragm (20a, 20b) of both pressure shoes (3a, 3b) comprises pinholes (25) for transporting hydraulic fluid in the pressure chamber (10a, 10b) from the pressure chamber to the press belt (6a, 6b) to lubricate the press belt.

3. A press as claimed in claim 1 or 2, **c h a r a c t e r i z e d** in that the diameter of the pinholes (25) is 0.01 to 10 micrometers.

4. A press as claimed in claim 3, **c h a r a c t e r i z e d** in that the diameter of the pinholes (25) is 1 to 10 micrometers.

5. A press as claimed in claim 1 or 2, **c h a r a c t e r i z e d** in that the pressure-balancing diaphragm (20; 20a, 20b) is made of a uniform rectangular element.

6. A press as claimed in claim 5, **c h a r a c t e r i z e d** in that the pressure balancing diaphragm (20; 20a, 20b) is made of a 0.2 to 3-mm thick stainless steel plate and protrudes in its edge-zone (21) towards the pressure chamber (10) at least mainly unsupported a distance of L = 20 to 40 mm.

7. A press as claimed in claim 6, **c h a r a c t e r i z e d** in that the inner rim of the pressure balancing diaphragm (20; 20a, 20b) is at its outermost section bent towards the pressure shoe body (18) to form a wedge-like inlet slot to the press belt (6).

8. A press as claimed in claim 1 or 2, **c h a r a c t e r i z e d** in that the surface of the pressure shoe that is towards the press belt (6; 6a, 6b) is bevelled towards the outer rim (28; 28a, 28b) of the pressure shoe in such a

manner that the bevelled section (15) forms a 5 to 10-degree angle with respect to the top level of the pressure shoe.

9. A press as claimed in claim 8, **characterized** in that the pressure balancing diaphragm (20; 20a, 20b) is fastened to the bevelled surface (15) of the pressure shoe by a weld joint (16) running along the rim of the pressure balancing diaphragm.

10. A press as claimed in any one of the preceding claims, **characterized** in that the pressure-balancing diaphragm (20; 20a, 20b) is made of stainless steel.

11. A pressure-balancing diaphragm (20) comprising an outer rim (26), an inner rim (22) and an opening (27) defined by the inner rim, **characterized** in that the diaphragm comprises pinholes (25) in an edge-zone (21) close to the inner rim (22).

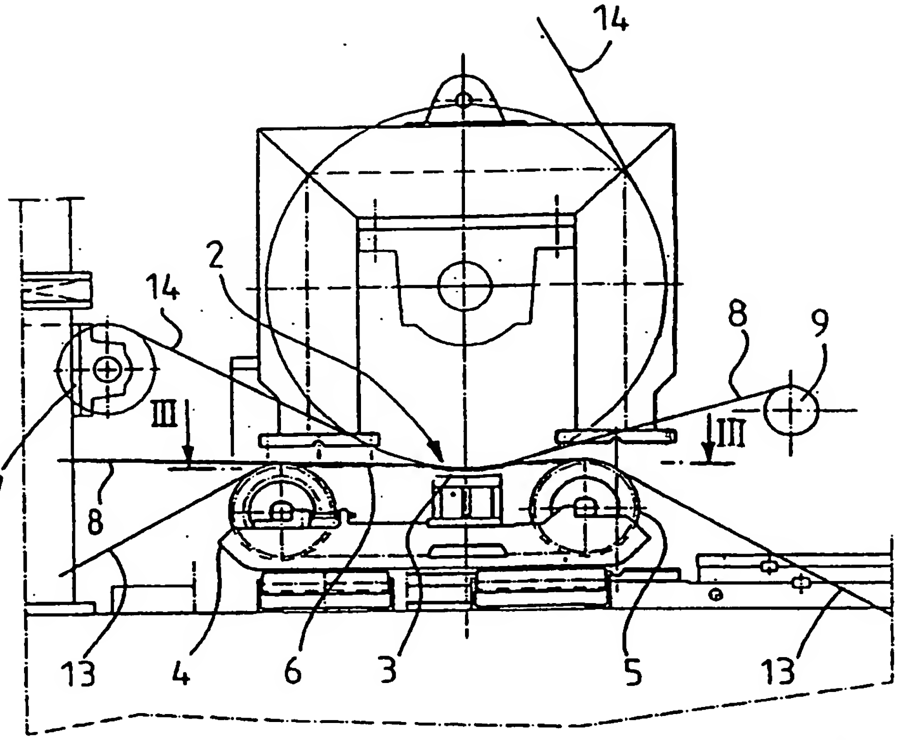

FIG. 1

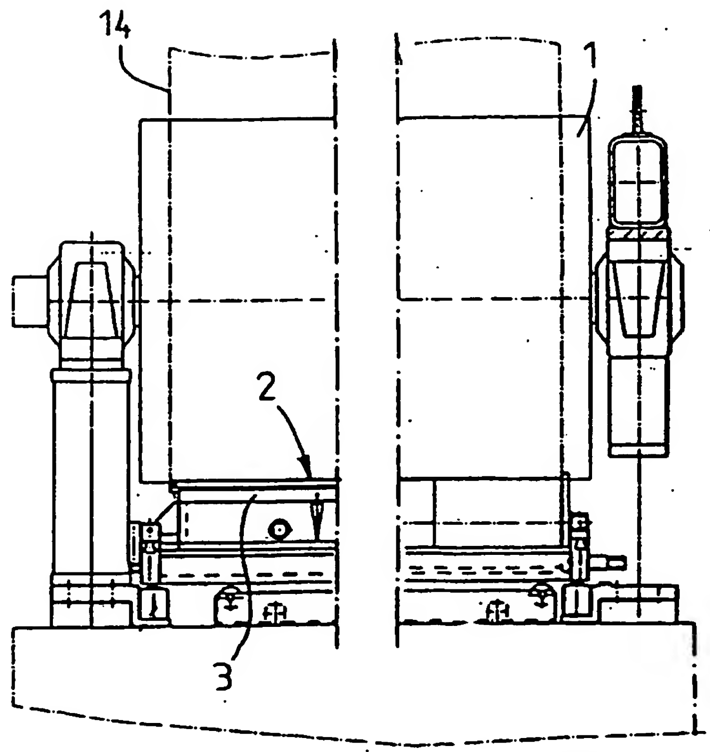

FIG. 2

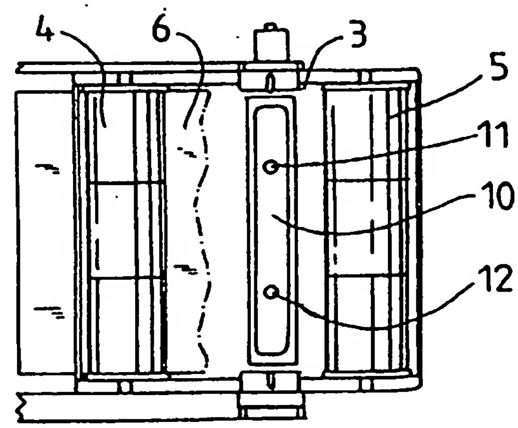

FIG. 3

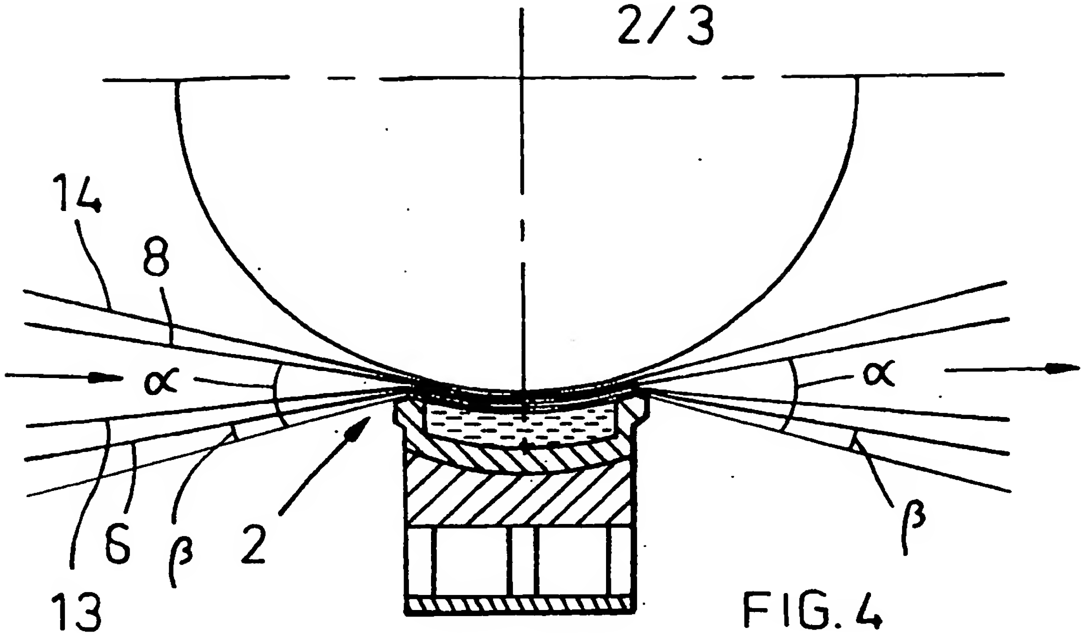

FIG. 4

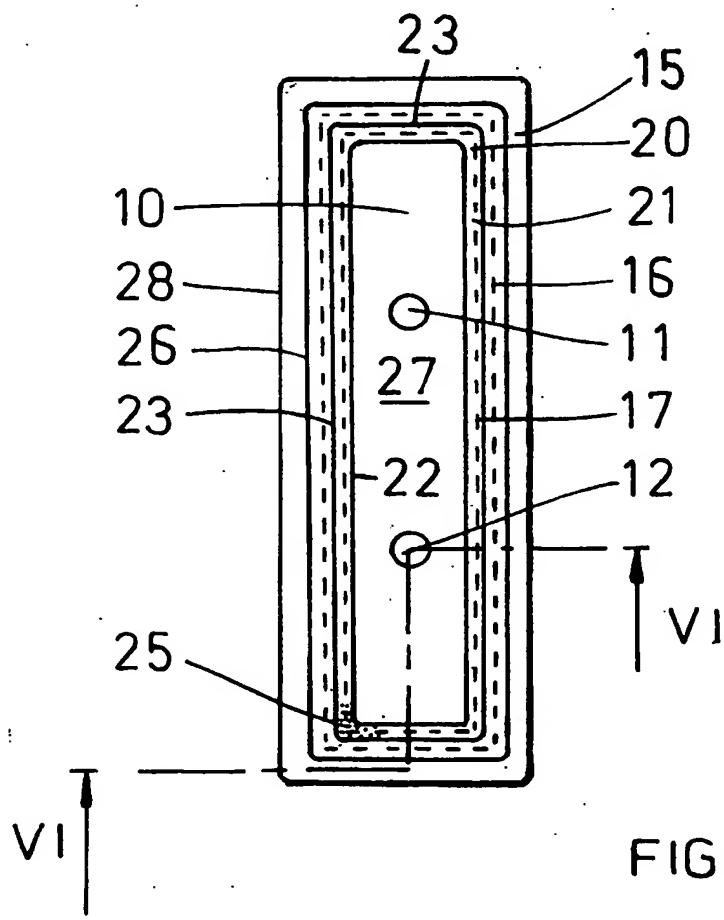

FIG. 5

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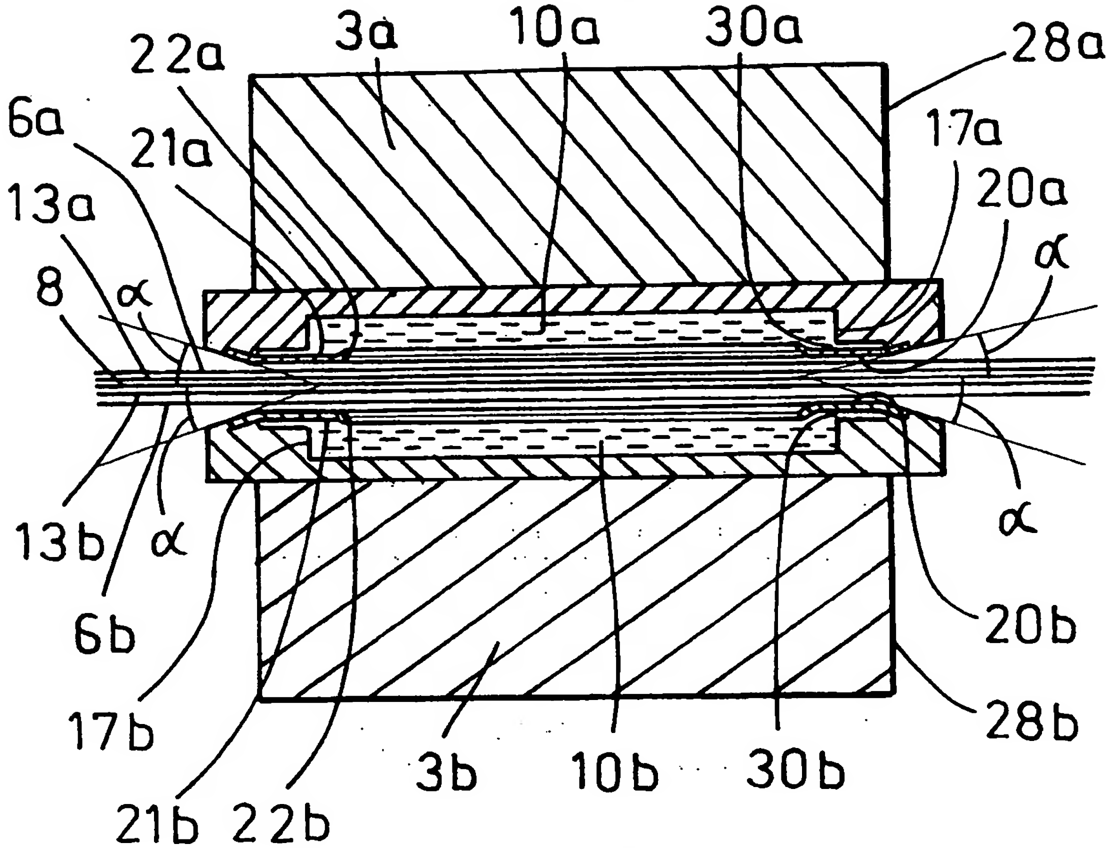
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FIG. 7

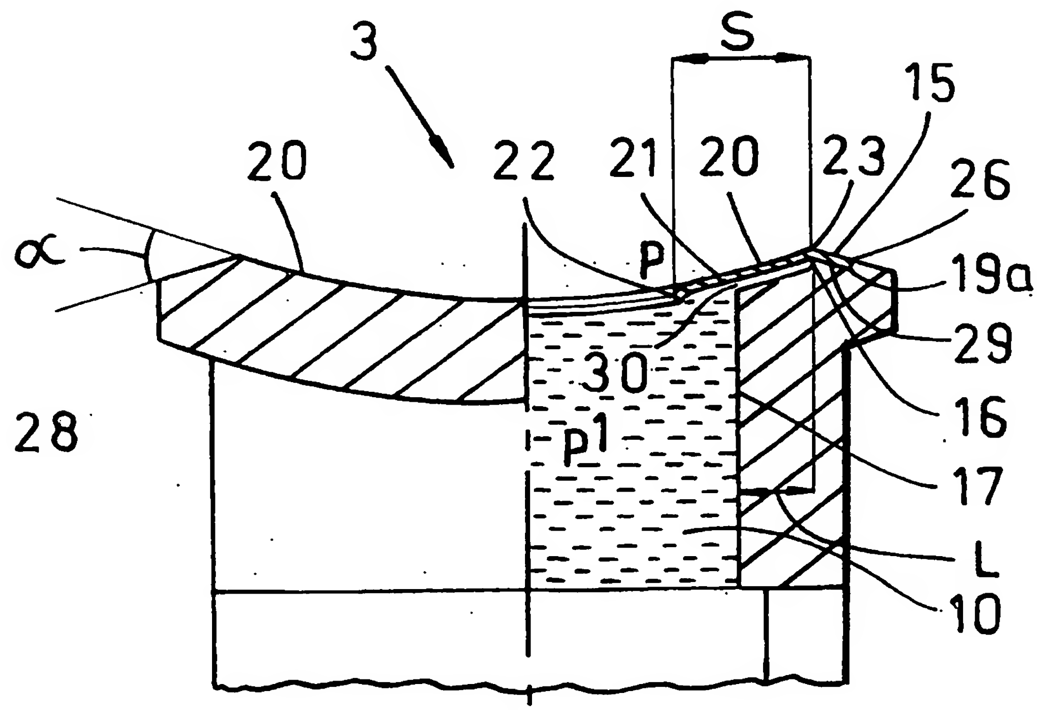
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FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 01/01041

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21F 3/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FI 94368 C (RAJAMÄKI, TEUVO), 12 August 1997 (12.08.97), figures 5,6, abstract	1-11
	--	
A	EP 0777012 A1 (VOITH SULZER PAPIERMASCHINEN GMBH), 4 June 1997 (04.06.97), figures 1,5, claim 1	1-11
	--	

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 March 2002	11-03-2002
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Wiva Asplund/ELY Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT
Information on patent family members

28/01/02

International application No.
PCT/FI 01/01041

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